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STRATIGRAPHIC DISTRIBUTION OF THE FORAMINIFERS OF THE OVČE POLE PALEOGENE BASIN IN THE REPUBLIC OF MACEDONIA

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A b s t r a c t: The Ovče Pole basin is a large sedimentary mass situated in the eastern part of the Vardar zone in the territory of the Republic of Macedonia. Investigations have determined that the mass is 3.5 km thick and composed of four lithozones: basal lihtozone, lower flysch lithozones, lithozones of yellow sandstones and upper flysch lithozone.

The geological age of the sediments has been defined as Upper Eocene based of investigations carried out so far on numerous fossil remains of microfossil groups.

The paper presents the results of the micropaleontological investigations on foraminifer fauna discovered in the upper flysch lithozones, which are important for the understanding of the basin.

The biostratigraphic significance of the foraminifer fauna in the Paleogene sediments has a stratigraphic distribution of 53 species of benthic and plankton foraminifer fauna, obtained from 5 Paleogene cross-sections.

Systematic classification of foraminifer fauna has been carried out after Loeblich and Tappan, 1988.

Key words: Paleogene; benthic and planktonic foraminifers; stratigraphy; Ovče Pole basin

INTRODUCTION

The Ovče Pole basin is a large sedimentary mass situated in the eastern part of the Vardar zone in the territory of the Republic of Macedonia (Fig. 1).

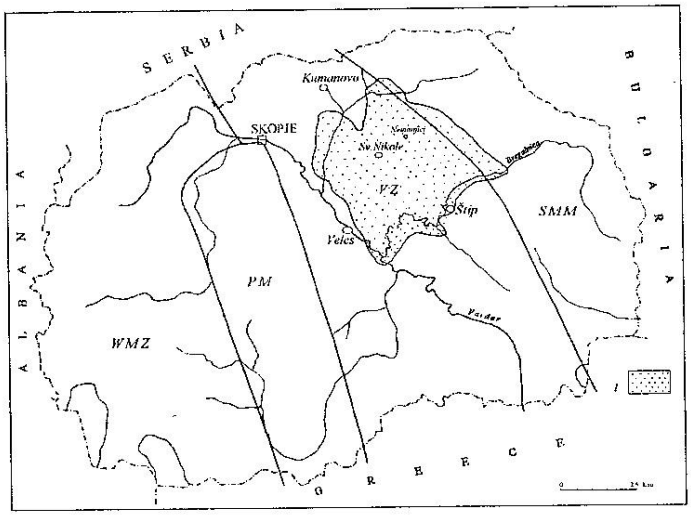

Fig.1. Map of regional tectonic setting of the R of Macedonia.
SMM – Serbian-Macedonian massif, VZ – Vardar zone, PM – Pelagonian massif, WMZ – Western Macedonian zone;
1 – Ovče Pole paleogene basin.

The sediments have been subject of investigations of many authors, mostly of regional nature. Based on investigations carried out so far the age of Paleogene sediments was determined as Upper Eocene based on numerous fossil remains of microfossil groups.

According to lithologic characteristics the 3.5 km thick Paleogene mass was composed of four lithostratigraphic units (lithozones): basal lithozone, lower flysch lithozone, lithozone of yellow sandstones and upper flysch lithozne.

The subject of this paper is micropaleontologic investigation of the foraminifer fauna in the Paleogene sediments.

The investigations included all lithologic levels in five Paleogene cross-sections where abundant foraminifer fauna was discovered. The foraminifer assemblage also made it possible to observe and analyse the stratigraphic distribution of foraminifer taxa in the basin.

MATERIAL AND METHODS OF INVESTIGATION

The study of the biostratigraphic importance of the foraminifer fauna included also the study of biostarigraphic distribution of 63 species obtained from 90 samples of 5 cross-sections discovered in the basin: Čardaklija, Kadrifakovo, Karaorman, Ežovo Brdo and Nemanjici (Fig. 2).

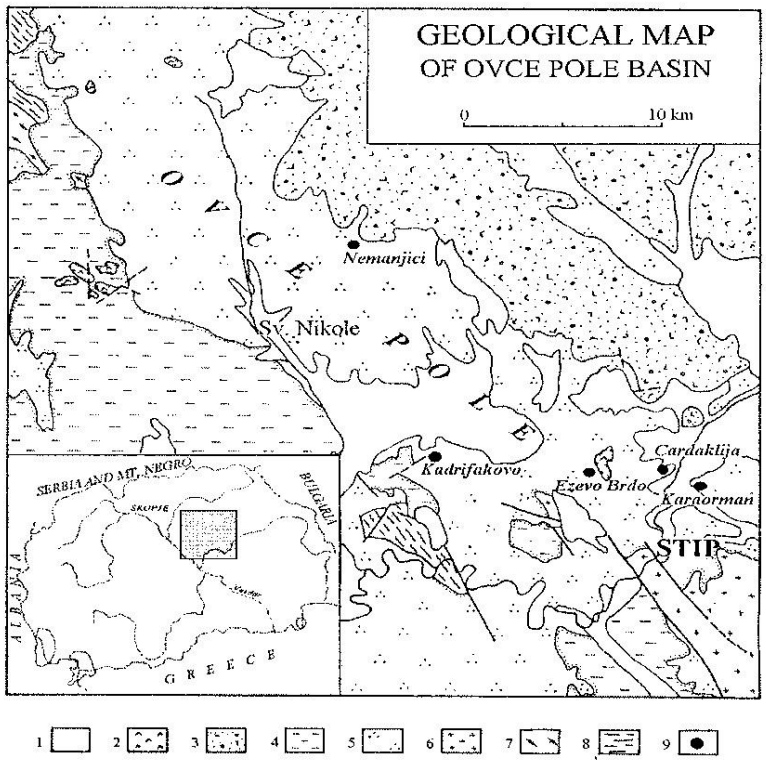

Fig. 2. Geological map of the Ovče Pole basin
1. Quaternary; 2. Early effusive rocks; 3. Tertiary volcanogene-sedimentary rocks; 4. Neogene sediments; 5. Upper Eocene sediments; 6. Jurassic granites; 7. Jurassic diabase gabbroes; 8. Paleozoic schists; 9. Sampling stites

Sampling of foraminifer fauna of the Paleogene cross-sections was carried out in 3 – 4 m intervals.

Technical processing was done according to classical methods of micropaleontological analysis (decomposition, washing, drying, selecting and determination). Paleontological determinations were carried out with a Zeiss microscope binocular 50 to 80 magnification. Microphotographs with scanning electronic microscope Philips SEM – 515 were carried out on selected foraminifer tests.

RESULTS

Field investigations included sampling in 5 Paleogene cross-sections: Čardaklija, Kadrifakovo, Karaorman, Ežovo Brdo and Nemanjici.

Lithological members of the cross-sections mentioned are present as sediments of the upper flysch lithozones: clayey sandy layers that grade into one another and interchange with sandstones, alevrolites, slates, marly clays and oolithic limestones.

Micropaleotological investigation of Paleogene sediments discovered abundant and versatile assemblage of foraminifer fauna.

Foraminifer investigations included all lithological levels of the Paleogene such as the basal and lower flysch lithozone, that of yellow sandstones and upper flysch lithozones. The results of the micropaleontological investigations of the middle and upper levels of the upper flysch lithozone were yellowish and rich in foraminifer fauna, whereas the results of the three lithozones (basal, lower flysch and lithozone of yellow sadnstones) were negative for foraminifers.

The collection of foraminifer fauna discovered consisted of 63 species that belong to 30 genres with 57 species of benthic foraminifer and 1 genre with 6 species of plankton foraminifer. The genres are the families as follows: *Spiroplectamminidae, Eggerellinidae, Textulariidae, Spiroloculinidae, Hauerinidae, Nodosaridae, Lagenidae, Glandulinidae, Globigerinidae, Bolivinidae, Buliminidae, Fursenkoinidae, Caucasinidae, Stilostomellidae, Baggenidae, Eponididae, Cibicididae, Nonionidae, Chilostomellidae, Heterolepidae, Gavelinellidae, Rotaliidae.*

Systematic classification of foraminifer fauna in the basin was carried out according to Loeblich and Tappan (1988).

The investigations discovered a wide distribution of foraminifer species. At same time the analysis of the stratigraphic location of certain taxa made it possible to infer that, in terms of age, five groups of foraminifers can be defined (Fig.3). The following genres belong here:

The first group consists of foraminifers wisespread during the Upper Eocene and offer the most reliable data in the determination of the age. Here belong species as follows: *Spiroplectamina carinata carinata* (d'Orbigny), *Dentalina communis* (d'Orbigny), *Palmula budensis* (Hantken), *Textularia minuta* Terquem, *Spiroloculina communis communis* Cushman and Todd, *Lagena humifera* Bandy, *Bolivina cf. antegressa* Subbotina, *Bolivina gracilis* Cushman, *Bolivina reticulata* Hantken, *Bulimina sculptilis* Cushman, *Caucasina eocenica* Chalilov, *Siphonodosaria verneuili* (d'Orbigny) and *Pararotalia audoini* (d'Orbigny).

The second group consists of species belonging to lower levels that are distributed as far as Upper Eocene (E_3) including *Spiroplectamina dentata* (Alth), *Dorothia indentanta* (Cushman et Jarvis), *Tehtularia minuta* Terquem, *Triloculina angularis* d'Orbigny, *Triloculina gibba* d'Orbigny, *Lenticulina cf. ellisori* (Bowen), *Lagena scalariformis* (Williamson), *Eponides minima* Cushman, *Cibicides carinatus* (Terquem), *Cibicides lobatulus* (Walker et Jakob), *Cibicides tallahatensis* Bandy, *Anomalinoides welleri* (Plumer), *Gavelinella danica* (Brotzen) and *Pararotalia subinermis* Bhatia.

The third group consists of transitional species for the Eocene (E) – Oligocene (Ol) boundary consisting of the following: *Quinqueloculina juleana* d'Orbigny, *Lenticulina yaguatensis* (Bermudez), *Percultazonaria fragara* (Gümbel), *Lagena striata* (d'Orbigny), *Globulina gibba* d'Orbigny, *Glandulina laevigata* d'Orbigny, *Globigerina yeguaensis* Weinzierl and Applin, *Bolivina scalprata* Schwager, *Bulimina trigona* Terquem, *Fursenkoina dibollensis* Cushman et Applin, *Siphonodosaria cf. adollphina* (d'Orbigny), *Cancris subconicus* (Terquem), *Cibicides cf. westi* Howe, *Cibicides ungerianus* (d'Orbigny), *Nonion graniferum* (Terquem), *Nonionella winniana* (Howe), *Pullenia quinqueloba* (Reuss), *Heterolepa dutemplei* (d'Orbigny), *Gyroidina soldani* d'Orbigny and *Hanzawaia cf.producta* (Terquem).

The fourth group consists of species that lived earlier than Upper Eocene – E_3 (the species formed due to resettling of later parts) consisting of *Valvulineria laevis* Brotzen, *Eponides saginarus* Bykova, *Cibicidoides lectus* (Vasilenko).

The fifth group consists of species that lived later than the Eocene. The following genres comprise the group *Textularia bronniana* d'Orbigny, *Glandulina ovula* d'Orbigny, *Globigerina ciperoensis angulisuturalia* Bolli, *Bulimina costata* d'Orbigny and *Caucasina tenebricosa* Pischanova.

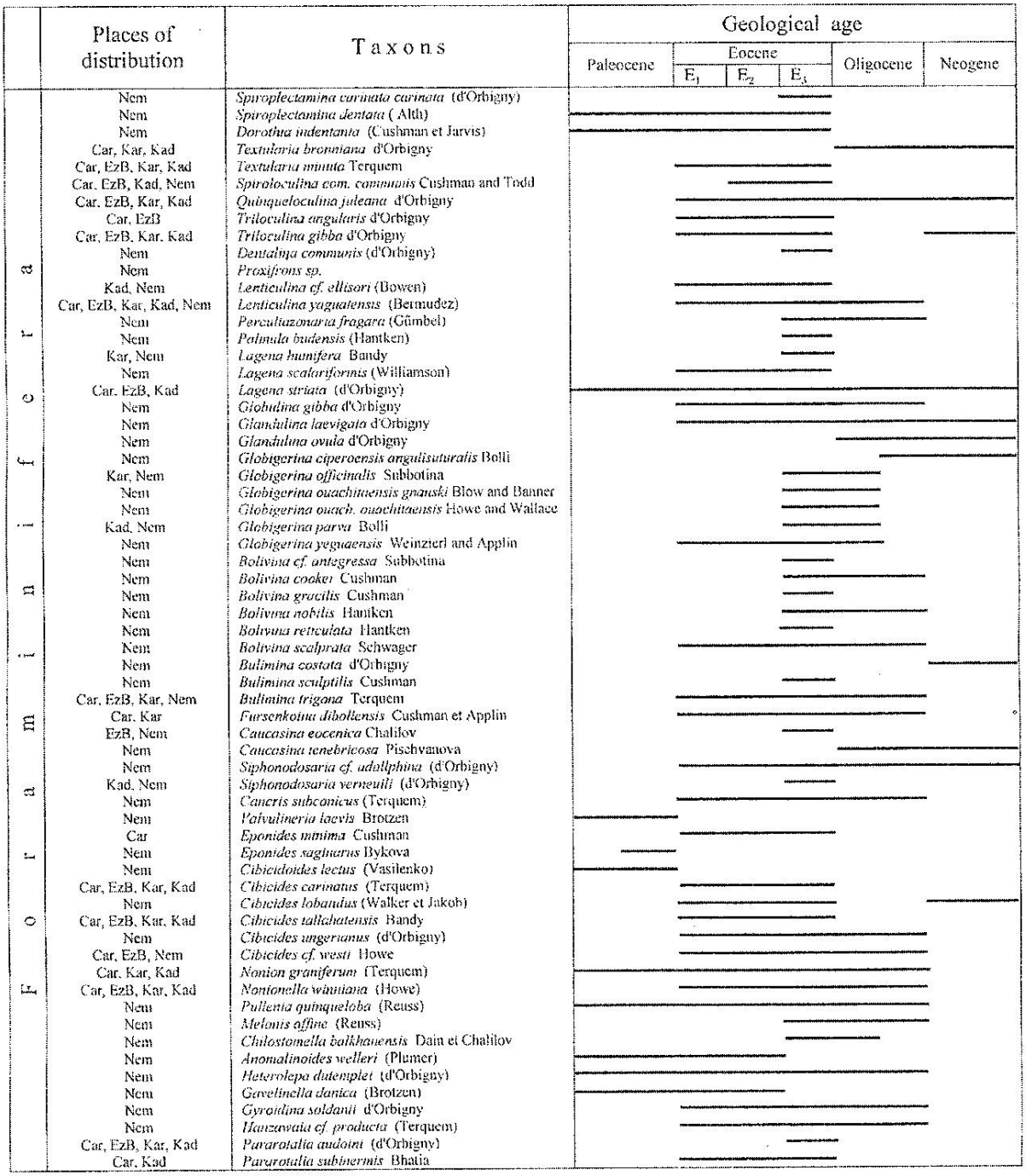

Fig. 3. Stratigraphic distribution of foraminifers from the Ovče Pole basin.
Explanation: Car – Čardaklija, EzB – Ežovo Brdo, Kar – Karaorman, Kad – Kadrifakovo, Nem – Nemanjici

The assemblage of benthic foraminifers of the first group *Spiroplectamina carinata carinata* (d'Orbigny), *Dentalina communis* (d'Orbigny), *Palmula budensis* (Hantken), *Textularia minuta* Terquem, *Spiroloculina communis communis* Cushman and Todd, *Lagena humifera* Bandy, *Bolivina cf. antegressa* Subbotina, *Bolivina gracilis* Cushman, *Bolivina reticulata* Hantken, *Bulimina sculptilis* Cushman, *Caucasina eocenica* Chalilov, *Siphonodosaria verneuili* (d'Orbigny) and *Pararotalia audoini* (d'Orbigny) is characteristic only of Upper Eocene and made it possible to distinguish only one biozone – the *Bolivina antegressa* (Fig. 4).

		Zones, subzones accordiry to benthic foraminifers	
EOCENE	Upper	Planulina costata	Bolivina antegressa
			Brotzenella taurica
	Middle	Caucasinella pseudoelongata	
		Haplophragmoides orfaensis	
		Uvigerina costellata	
	Lower	Pseudogaudryina pseudonavarroana	Turkmenella ninikae
			Bulimina mitgarziana
		Pseudogaudryina externa	

Fig. 4. Zonal distribution of Eocene according to benthonic foraminifers (Bugrova, 1988)

The criterion for distinguishing of *Bolivina antegressa* is the appearance and disappearance of taxa of the Bolivina group represents with *Bolivina antegressa* Subb., *Bolivina gracilis* Cushman and *Bolivina reticulata* Hantken. The *Bolivina antegressa* distinguished and the benthinic species belongs to the upper portion of the *Planulina costana zone* (Bugrova, 1988) belonging to the Upper Eocene – Priabonian geological age.

CONCLUSION

The results obtained for the stratigraphic distribution of benthic and plankton foraminifers in the Ovče Pole basin made it possible to identify the *Bolivina antegressa* biostratigraphic subzone (Bugrova, 1988) of the Upper Eocene – Priabonian geological age.

Based on the data it can be said that the geological age of the Paleogene sediments of the middle an upper flysch lihtiozone in the Ovče Pole basin belong to the Upper Eocene – Preabonian.

The results of foraminifer investigations in the basal, lower flysch lithozone and the lithozone of the yellow sandstones were negative and no reliable data are available regarding microfauna age. However, investigations offered a wide spectrum of distribution of foraminifer species for the whole Eocene (E_1. E_2. E_3.) from which it can be inferred that the lower levels of the Ovče Pole Paleogene (basal, lower flysch lithozne and lithozone of yellow sandstones) are older than Upper Eocene. This is also and indicator that the basin probably commenced formation by the end of Lower Eocene.

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Резиме

СТРАТИГРАФСКА РАСПРОСТРАНЕТОСТ НА ФОРАМИНИФЕРИТЕ ОД ОВЧЕПОЛСКИОТ ПАЛЕОГЕНСКИ БАСЕН ВО РЕПУБЛИКА МАКЕДОНИЈА

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Клучни зборови: палеоген; бентосни и планктонски фораминифери; стратиграфија; овчеполски басен

Овчеполскиот палеогенски басен претставува голема седиментна маса сместена во источниот дел на Вардарската зона на територијата на Република Македонија.

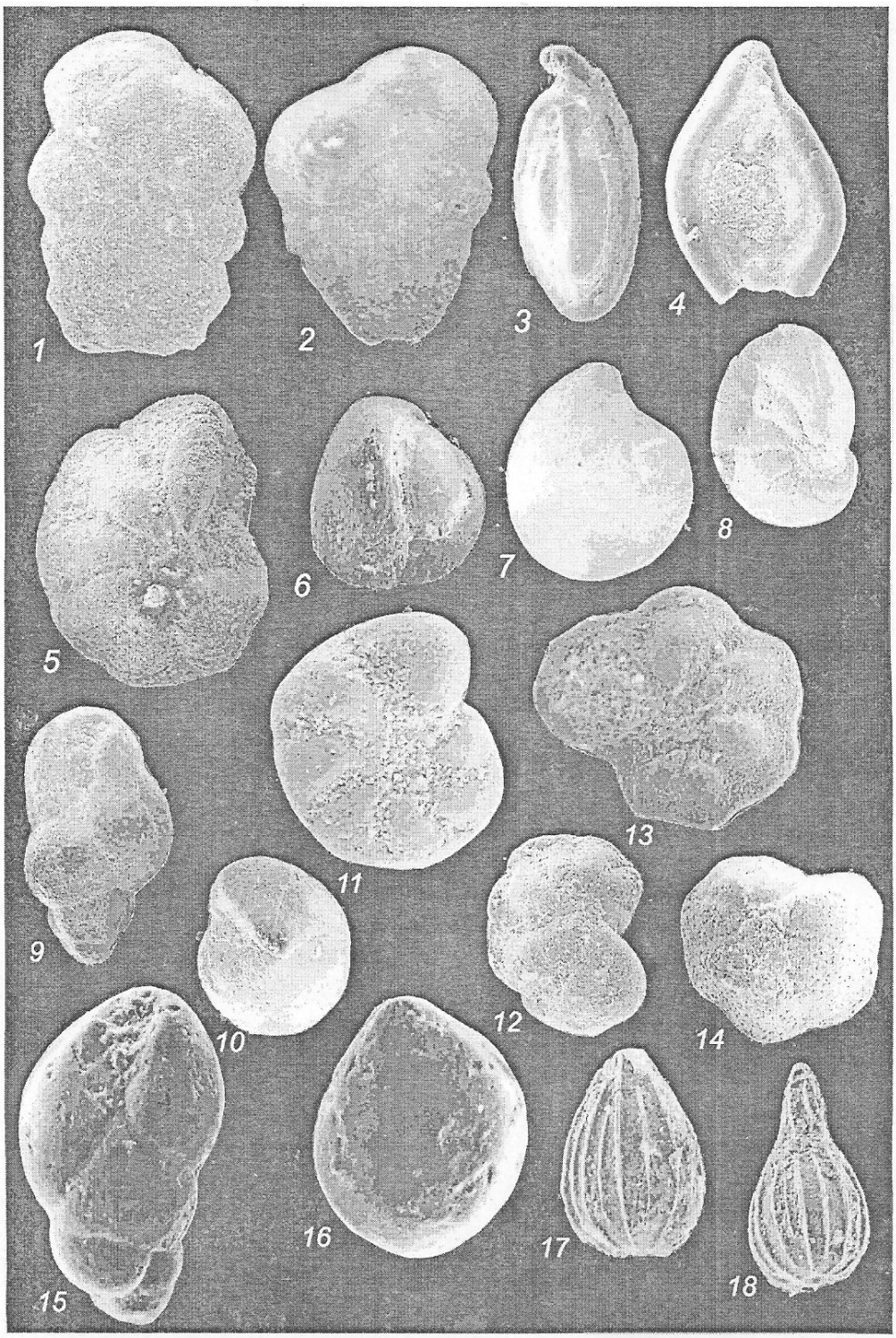
Според досегашните истражувања масата дебела околу 3.5 km е изградена од 4 литозони: базална литозона, долна флишна литозона, литозона на жолти песочници и горна флишна литозона.

Геолошката старост на седиментите во овчеполскиот басен е одредена како горно еоценска, врз основа на досегашните истражувања на база на многубројни фосилни остатоци од макрофосилните групи.

Во трудот ги презентираме резултатите од микропалеонтолошките истражувања на фораминиферната фауна, пронајдена во горната флишна литозона на овчеполскиот палеогенски басен, кои се мошне важни во расчленувањето на стратиграфијата на басенот.

Биостратиграфската вредност на фораминиферната фауна во палеогените седименти на басенот е проследена со стратиграфска распространетост на 63 вида бентосна и планктонска фораминиферна фауна, добиена од 5 откриени палеогени профили на овчеполскиот басен.

Систематската класификација на фораминиферната фауна во басенот е направена според Loeblich & Tappan, 1988.



P L A T E I. 1. *Textularia bronniana* d'Orbigny. Car, Kar, Kad, Ol-N. SEM×156; **2.** *Textularia minuta* Terquem. Car, EzB, Kar, Kad, E_1-E_3, SEM×178; **3.** *Quinqueloculina juleana* d`Orbigny. Car, EzB, Kar, Kad, E-Ol-N, SEM×137; **4.** *Spiroloculina communis communis* Cushman et Todd. Car, EzB, Kad, Nem, $E_2$-$E_3$, SEM×137; **5.** *Pararotalia audouini* (d`Orbigny). Car, EzB, Kar, Kad, E_3, SEM×143; **6.** *Triloculina gibba* d`Orbigny. Car, EzB, Kar, Kad, E_1-E_3, SEM×150; **7.** *Lenticulina yaguatensis* (Bermudez). Car, EzB, Kar, Kad, Nem, E-Ol, SEM×170; **8.** *Nonionella winniana* Howe. Car, EzB, Kar, Kad, E-Ol, SEM×126; **9.** *Bulimina trigona* Terquem. Car, EzB, Kar, Kad, E-Ol, SEM×186; **10.** *Cibicides tallahatensis* Bandy. Car, EzB, Kar, Kad, E_1-E_3, SEM×143; 11. *Nonion graniferum* (Terquem). Car, Kar, Kad, Pc-Ol, SEM×287; **12.** *Cibicides carinatus* (Terquem). Car, EzB, Kar, Kad, E_1-E_3, SEM×126; **13.** *Pararotalia subinermis* Bhatia. Car, Kad, E_1-E_3, SEM×203; **14.** *Cibicides cf. westi* Howe. Car, EzB, Nem, E-Ol, SEM ×150; **15.** *Caucasina tenebricosa* Pishvanova. Nem, Ol-N, SEM×300; **16.** *Glandulina laevigata* d'Orbigny. Nem, E-N, SEM×285; **17.** *Lagena humifera* Bandy. Kar, Nem, E_3, SEM×221; **18.** *Lagena striata* (d`Orbigny). Car, EzB, Kad, Pc-N, SEM×221

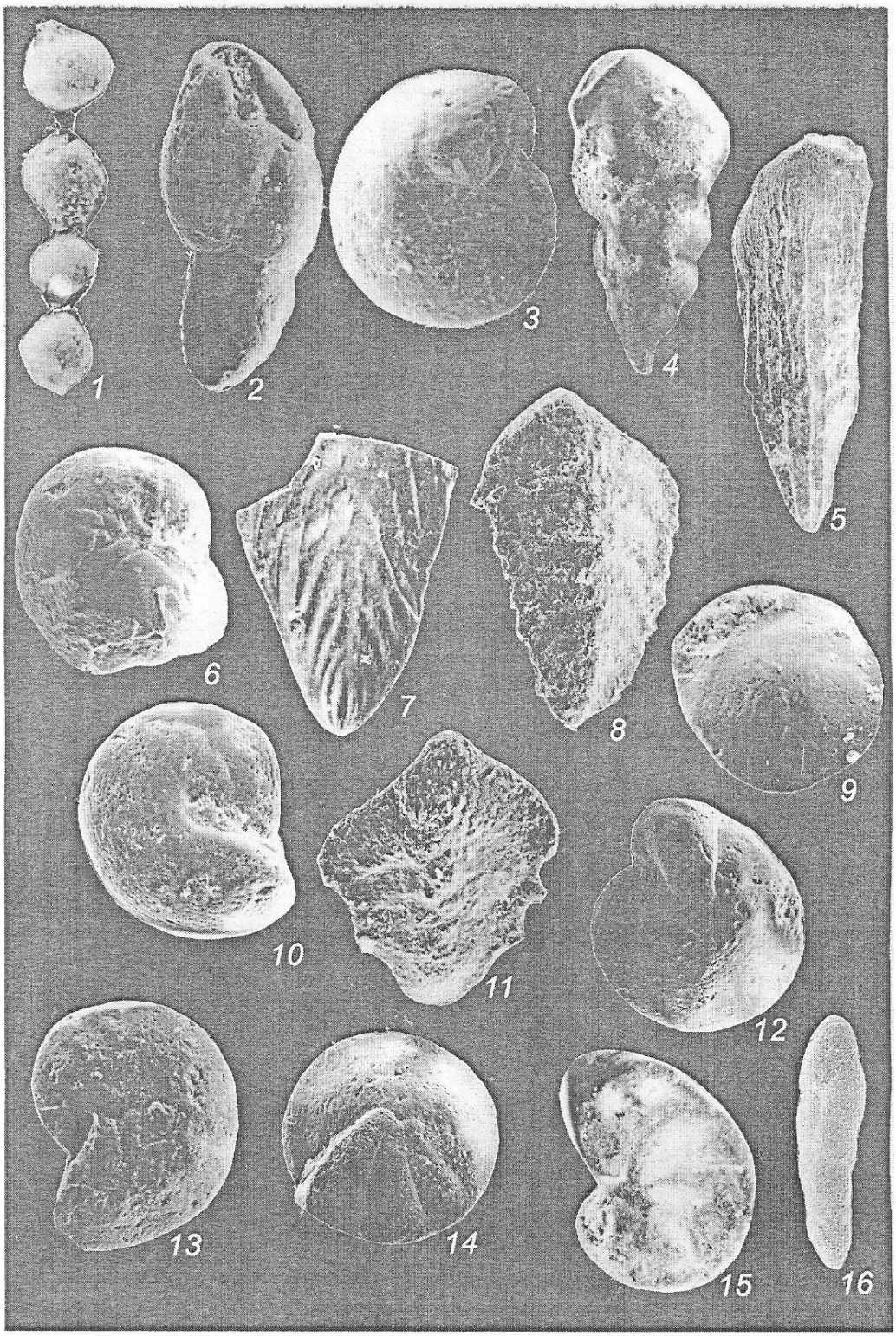
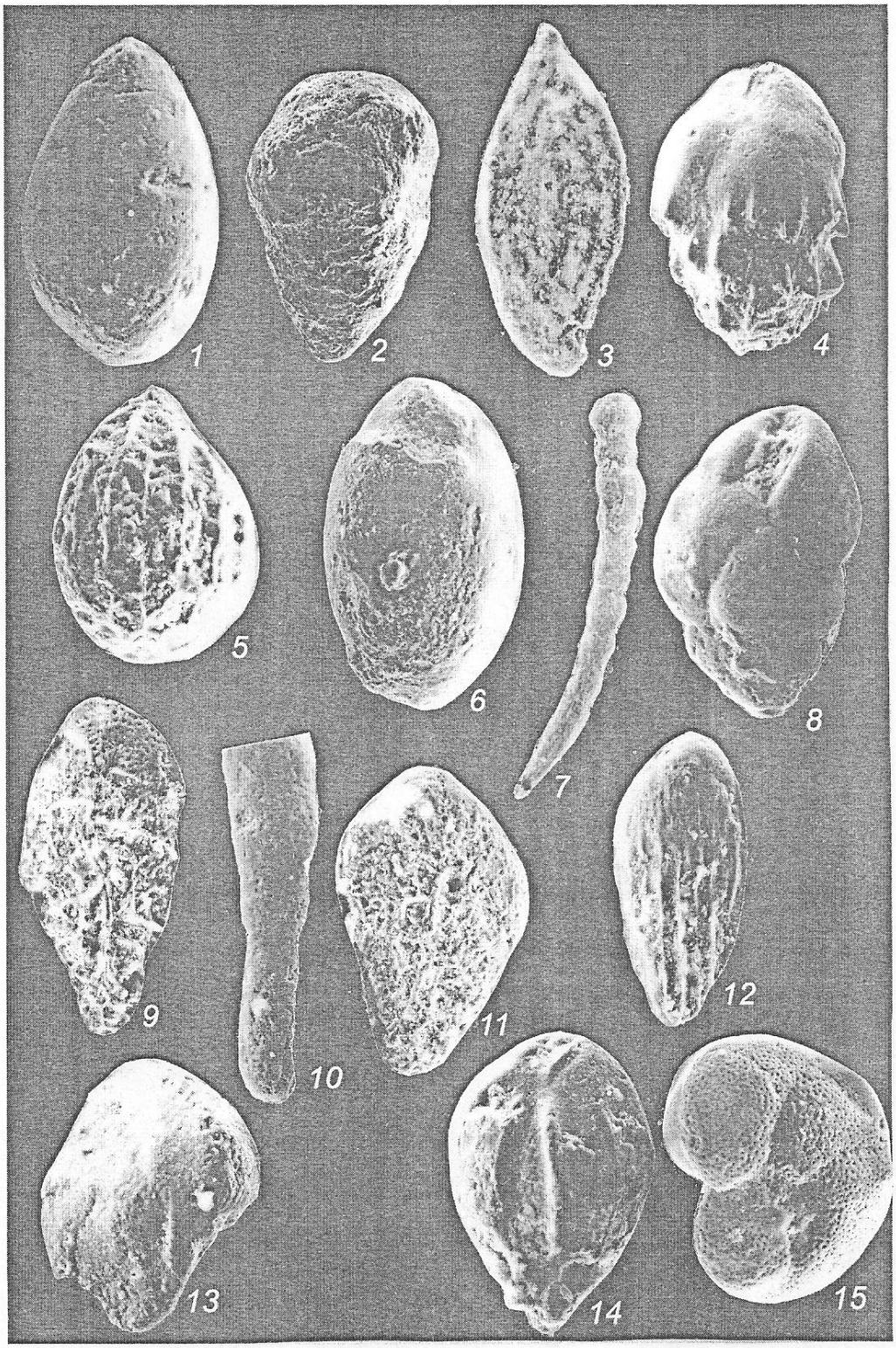


PLATE II. 1. *Siphonodosaria verneuili* (d'Orbigny). Kad, Nem, E_3, SEM×110; **2.** *Caucasina eocenica* Chalilov. EzB, Nem, E_3, SEM×240; **3.** *Gyroidina soldani* d'Orbigny. Nem, E-N, SEM×220; **4.** *Bolivina gracilis* Cushman and Apllin. Nem, E_3, SEM×185; **5.** *Bolivina cf. antegressa* Subbotina. Nem, E_3, SEM×140; **6.** *Cancris subconicus* (Terquem). Nem, E-Ol, SEM×180; **7.** *Palmula budensis* (Hantken). Nem, E_3, SEM×180; **8.** *Spiroplectamina carinata carinata* (d'Orbigny). Nem, E_3, SEM×100; **9.** *Eponides saginarus* Bykova. Nem, Pc, SEM×200; **10.** *Mellonis affine* (Reuss). Nem, E_3-Ol, SEM×220; **11.** *Spiroplectamina dentata* (Alth). Nem, Pc-E_3, SEM×220; **12.** *Lenticulina cf. ellisori* (Bowen). Kad, Nem, E_1- E_3, SEM×340; **13.** *Cibicides ungerianus* (d'Orbigny). Nem, E_1- Ol, SEM×240; **14.** *Heterolepa dutemplei* (d'Orbigny). Nem, Pc-Ol, SEM×120; **15.** *Cibicides cf. westi* Howe. Car, EzB, Nem, E_1-Ol, SEM×150; **16.** *Fursenkoina dibolensis* (Cushman et Applin). Car, Kar, E_1-Ol, SEM× 93



P L A T E III. 1. *Glandulina ovula* d'Orbigny. Nem, Ol-N, SEM×400; **2.** *Dorothia indentanta* (Cushman et Jarvis). Nem, Pc-E, SEM×200; **3.** *Spiroloculina communis communis* Cushman and Todd. Car, EzB, Kad, Nem, E_2-E_3, SEM×137; **4.** *Bulimina costata* d'Orbigny. Nem, Ne, SEM×240; **5.** *Lagena scalariformis* (Williamson). Nem, E_1-E_3, SEM×340; **6.** *Chilostomella balkanensis* Dain et Chalilov. Nem, E_2-E_3, SEM×250; **7.** *Siphonodosaria verneuili* (d'Orbigny). Kad, Nem, E_3, SEM×300; **8.** *Bulimina trigona* Terquem. Car, EzB, Kar, Nem, E-Ol, SEM×186; **9.** *Bolivina scalprata* Scwager. Nem, E_3, SEM×250; **10.** *Dentalina communis.* (d'Orbigny). Nem, E_3, SEM×200; **11.** *Bolivina reticulata* Hantken. Nem, E_3, SEM×250; **12.** *Bolivina nobilis* Hantken. Nem, E_3-Ol, SEM×325; **13.** *Valvulineria laevis* Brotzen. Nem, Pc, SEM×340; **14.** *Bulimina sculptilis* Cushman. Nem, E_3, SEM×300; **15.** *Gavelinella danica* (Brotzen). Nem, Pc-E_2, SEM×280

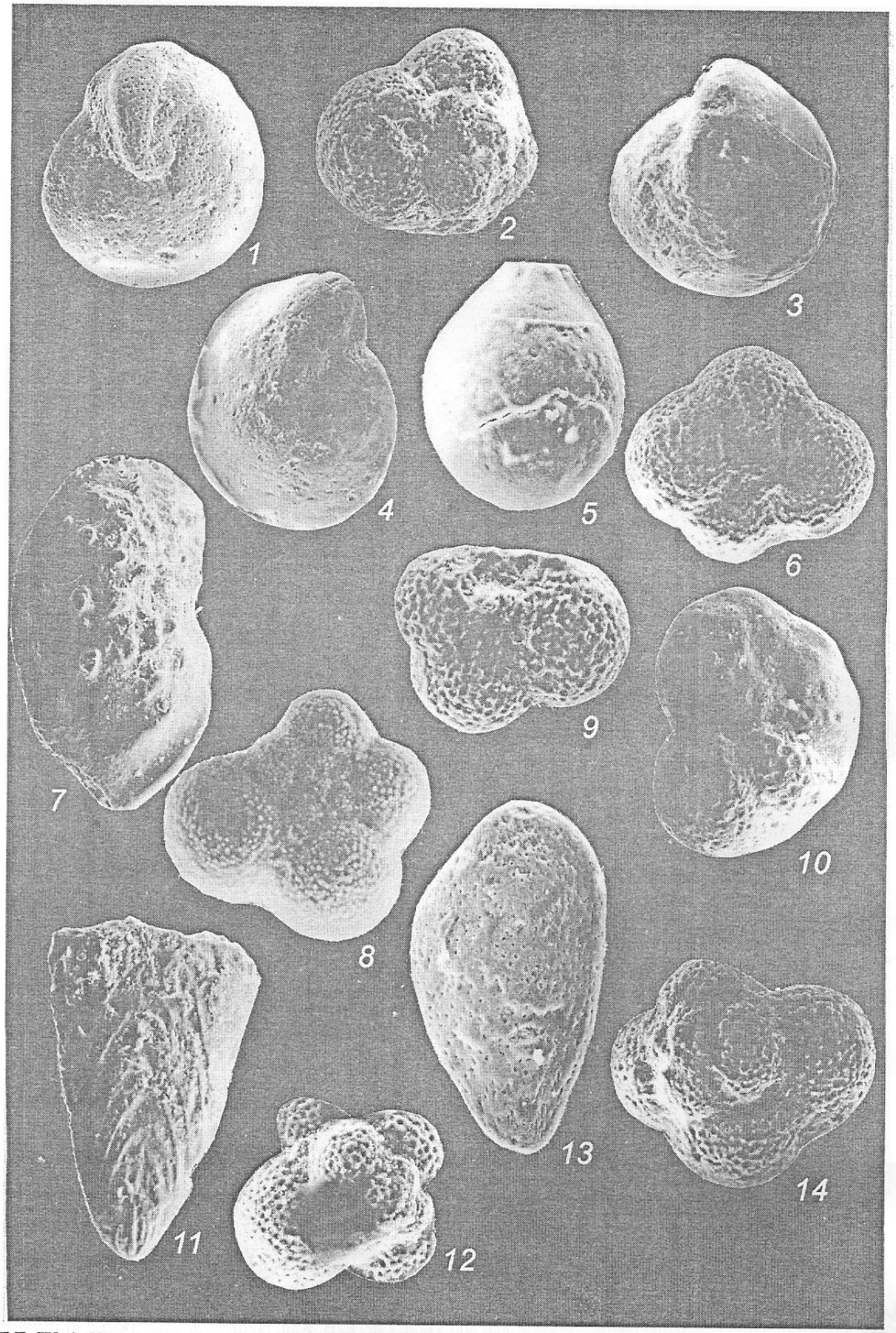


PLATE IV. 1. *Hanzawaia cf. producta* (Terquem). Nem, E_1-Ol, SEM×125; **2.** *Globigerina yeguaensis* Weinzierl and Applin. Nem, E_1-E_3, SEM×240; **3.** *Pullenia quinqueloba* (Reuss). Nem, Pc-Ol, SEM×260; **4.***Cibicidoides lectus* (Vasilenko). Nem, Pc, SEM×185; **5.** *Globulina gibba* d'Orbigny. Nem, E-Ol, SEM×400; **6.** *Globigerina officinalis* Subbotina. umbilical view; Kar, Nem, E_2 –Ol_1, SEM×285; **7.** *Percultazonaria fragara* (Gűmbel). Nem, E_3-Ol, SEM×110; **8.** *Globigerina ouachitaensis gnaucki* Blow et Banner. Nem, E_2–Ol_1, SEM×325; **9.** *Globigerina parva* Bolli. Kad, Nem, E_2–Ol_1, SEM×325; **10.** *Anomalinoides welleri* (Plummer). SEM×160; **11.** *Proxifroms sp.,* Nem, SEM×180; **12.** *Globigerina ciperoensis angulisuturalis* Bolli. Nem, Ol_1–N, SEM×300; **13.** *Bolivina cookei* Cushman. Nem, E_2-Ol, SEM×250; **14.** *Globigerina officinalis* Subbotina. spiral view; Kar, Nem, E_2 –Ol_1, SEM×275

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